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## The High School

### Ninth and Tenth Grades

**Latin, Eighth and Ninth Grades:** (KATHARINE M. STILWELL.) The class will continue the work in *Caesar*, as begun in April, by reading *The Helvetian War*. They are already more or less familiar, through their work in Roman history, with the efforts of Rome to replace the customs of the barbarian tribes with her law and order; and having studied the events which led up to this great struggle, they are in a measure prepared to understand its meaning.

The war will be treated as a piece of universal history, taught by means of maps, pictures, and such other aids as would be employed were the account written in the English language. Latin constructions will be noted and dwelt upon when such reference tends to interpret the thought. Attention will be paid to the Roman use of the subjunctive mode for expressing certain ideas. The class will read the text and discuss the points indicated in the following outline:

#### I. Cause of the Helvetian migration.

1. Geography of western Gaul—broad, rich plains, sloping from the Cevennes to the ocean, and watered by navigable rivers.

2. Geography of Helvetia—a narrow plateau walled in on the east and south by the Alps, on the west and north by the Jura, and separated from the Roman province by the Rhone. This little strip, at most 200 miles long by 120 miles broad, was the home of 400,000 Helvetians.

The class will be led to see these geographical conditions as the fundamental cause of the migration. They will picture the geography by means of a map which the teacher will sketch before them upon the blackboard. In developing it she will

use their knowledge, which she will supplement by vivid descriptions and by pictures.

Members of the class will be called upon to impersonate the Helvetian leaders, and to present arguments for and against removal.

#### II. The routes.

From the possible routes the class will determine the one to be taken. This will involve a detailed description, including a statement of the advantages and disadvantages of each. (Maps, pictures, and descriptions from literature will be used by the teacher.) The routes will be indicated on the map already upon the blackboard.

#### III. Caesar.

The decision to take the route to the south through the Roman province brings Caesar with his army over the Alps to the foot of Lake Geneva. The class will precede the army building the Roman road over the Alpine passes to the Rhone, and will watch the construction of the camp on its banks. Caesar's refusal to permit to the Helvetians a passage through the province will lead the class to a discussion of the following questions: Were the Helvetians justified in moving? What would have been the probable effect upon Rome if the Helvetians had carried out their plans? What effect upon our civilization? Was Caesar right in interfering?

#### IV. Building of the fortification.

The class will follow the construction of the wall from Lake Geneva to the Rhone, expressing the finished work in color.

#### V. Change of route.

As the class read of the change of route,

and Caesar's addition to the army, they will study the organization of the Roman army. In this connection they will read *The Roman Art of War in Caesar's Time* in the introduction to Kelsey's *Caesar*; also Mr. Gould's references on page 177 of the October COURSE OF STUDY.

The expression of the class in this month's work will be: the drawing of maps to show topography of the country and routes of travel; paintings of the wall built by Caesar on the south bank of the Rhone, showing Roman guards in their military equipment; drawings of a Roman camp and winter quarters of the army; clay-modeling of shields and standard, and written papers presenting the arguments of the leaders.

**Latin (Caesar), Ninth and Tenth Grades:** (KATHARINE M. STILWELL.) This class did not finish reading *The Helvetian War* till the middle of April. They have just started the account of the war with Ariovistus and the Germans; so the work for May will be carried on as planned by Mr. Gould in the April COURSE OF STUDY.

**German, Ninth and Tenth Grades:** (DR. SIEGFRIED BENIGNUS.) For exercises in grammar—especially in irregular verbs—in oral and written expression, the conquest of Greece by the Romans will be studied.

Reading: *Picturebook without Pictures*; memorizing: *Frühlingswanderung*, by Wilhelm Müller.

#### Frühlingswanderung

Der Mai ist auf dem Wege,  
Der Mai ist vor der Thür.  
Im Garten, auf den Wiesen,  
Ihr Blümlein, kommt herfür.

Da hab' ich den Stab genommen,  
Da hab' ich das Bündel geschnürt,  
Zieh weiter, immer weiter,  
Wohin die Strasse mich führt.

Und über mir ziehen die Vögel,  
Sie ziehen in lustigen Reihn,  
Sie zwitschern und trillern und flöten,  
Als ging's in den Himmel hinein.

Der Wanderer geht alleine,  
Geht schweigend seinen Gang.  
Das Bündel will ihn drücken,  
Der Weg wird ihm zu lang.

Ja, wenn wir allzusammen,  
So zögen ins Land hinein,  
Und wenn auch das nicht wäre,  
Könnt eine nur mit mir sein!

*Wilhelm Müller, 1794-1827.*

**French, Ninth and Tenth Grades:** (LORLEY ADA ASHLÉMAN.) These grades have been dramatizing *La Dernière Classe*, as stated in the April COURSE OF STUDY. Below is given Act I, showing the manner in which this work has been done.

### La Dernière Classe

#### Acte I

#### Scène Première

Le temps: Un matin de printemps. La lisière d'un bois au fond du théâtre. Une rue sur le devant.

(Un petit garçon entre marchant très lentement avec des livres sous le bras. Il regarde autour de lui avec envie.)

*Frantz.* Qu'il fait chaud. Le soleil brille bien fort, et les oiseaux, comme ils chantent! En vérité il fait trop beau pour aller à l'école. D'ailleurs si j'y vais, je serai grondé parceque je ne sais pas ma leçon au sujet des participes! Que ces choses sont stupides! Il faut trop travailler pour apprendre la langue française. (Il s'arrête et semble écouter.) Ah! Voilà les Prussiens qui font l'exercice dans le pré Rippert. Je crois que j'irai les voir. Non! Il faut aller—

Oh! il fait trop beau. Je n'irai pas à l'école. (Il entend l'horloge du village qui sonne le quart.) Déjà neuf heures et un quart. Je suis trop tard pour y aller. Mais que dira M. Hamel demain, et que dirai-je moi? Ce sera bien désagréable. Après tout il vaut mieux aller à l'école! (Il se met à courir dans la direction de l'école.)

**Scène Deuxième**

(Devant la mairie beaucoup de monde est arrêté près du grillage aux affiches.)

*Vieille Femme.* Maintenant que font ces Prussiens! Ha, ha! Vous voulez donc que nos enfants n'apprennent pas leur belle langue. (Tout le monde secoue la tête en désapprobation.) Misérables que vous êtes! Mais, vous allez voir! Mes petites (prenant un enfant dans ses bras et l'embrassant) apprendront le français.

(Deux jeunes filles passent.)

*Une Fille.* Quoi vous dites, qu'il faut maintenant toujours parler allemand. Je ne peux pas d'ailleurs, je ne le veux pas, non, jamais, jamais de ma vie!

(Un homme entre avec sa femme, qui tient un bébé dans ses bras.)

*L'Homme.* Ma pauvre femme, ce sont là les mauvaises nouvelles! Notre pauvre enfant! Mais, non, nous ne resterons plus dans ce pays! Nous irons à Paris.

*La Femme.* Mais ce serait si écœurant de quitter notre vieille maison.

(Le Forgeron Wachter et son apprenti entrent en scène.)

*Apprenti.* Monsieur Wachter, que dit cette affiche, s'il vous plaît?

*Le Forgeron.* Il faut, qu'après le quinze mai, toutes les personnes dans l'Alsace et dans la Lorraine parlent allemand! Tous ceux qui n'observeront pas cette commande dans les écoles seront punis. Signé, "Bismarck."

*Apprenti.* Qui est Bismarck?

*Le Forgeron.* Le chancelier de fer!

(Frantz entre. Il s'arrête en voyant l'affiche.)

*Frantz.* Qu'est-ce qu'il y a encore? (Il court vite vers l'école.)

*Le Forgeron (crie après lui).* Ne te dépêche pas tant, petit. Tu y arriveras toujours assez tôt à ton école. Ha! Ha! (Le petit garçon regarde derrière lui et court toujours vers l'école.)

(L'ancien facteur, accompagné de sa fille, lit l'affiche.)

*Le Facteur.* Depuis deux ans, ma fille, toutes les mauvaises nouvelles sont venues de là.

*La Fille du Facteur.* Eh, bien! Toi et moi, nous parlerons toujours français à la maison. Nous pouvons au moins garder notre langue.

**Scène Troisième**

(Les élèves sont déjà rangés à leur place, et M. Hamel passe et repasse avec la règle en fer sous le bras. Frantz ouvre la porte au milieu de ce grand calme. M. Hamel le regarde sans colère et lui dit très doucement.)

*M. Hamel.* Va vite à ta place, mon petit Frantz; nous allions commencer sans toi.

(Le maître porte sa belle redingote verte, son jabot plissé fin, et sa calotte de soie noire brodée. Toute la classe a quelque chose d'extraordinaire et de solennel. Sur les bancs qui restent vides d'habitude sont assis le vieux Hauser avec son tricorne, l'ancien maire, l'ancien facteur, et puis d'autres personnes encore. Tout le monde paraît triste, et Hauser a un vieil abécédaire mangé aux bords qu'il tient grand ouvert sur ses genoux avec ses grosses lunettes posées en travers des pages. M. Hamel monte dans sa chaire, et de la même voix douce et grave il dit.)

*M. Hamel.* Mes enfants, c'est la dernière fois que je vous fais la classe. L'ordre est venu de Berlin de ne plus enseigner que l'allemand dans les écoles de l'Alsace et de Lorraine. Le nouveau maître arrive demain. Aujourd'hui c'est votre dernière leçon de français. Je vous prie d'être bien attentifs.

(Ces quelques paroles bouleversent le petit Frantz, et il s'écrie.)

*Frantz.* Ah les misérables, voilà ce qu'ils avaient affiché à la mairie. Ma

dernière leçon de français. (Il se cache la figure dans les mains.)

*M. Hamel.* Oui, mon petit Frantz. (Il se tourne vers Jeanne.) Eh bien, Jeanne, allez au tableau noir et dites nous la règle du participe passé conjugué avec *avoir*. Ecrivez des exemples qui nous feront voir que vous comprenez bien la règle."

*Jeanne (écrit sur le tableau noir).* "J'ai fini ma leçon." Avec l'auxiliaire *avoir*, le participe passé est invariable quand l'objet direct suit le verbe.

"Je l'ai finie." Quand l'objet direct précède le verbe, le participe passé s'accorde avec l'objet direct.

*M. Hamel.* C'est très bien, ma petite. Louise, continuez.

*Louise.* Avec l'auxiliaire *être* le participe passé s'accorde avec le sujet. "La dame est venue."

*M. Hamel.* Bravo, Louise. Maintenant, Frantz, dites-moi encore une fois cette règle. (Frantz n'entend pas.) Frantz! Frantz! voyons, mon petit, les règles du participe.

*Frantz (à lui-même).* Mais je ne les sais pas. (Il se lève; et il essaye de réciter, mais il s'embrouille tout de suite.) L'auxiliaire *avoir*—avec, l'auxiliaire *avoir*, le par-ti-cipe—(Il reste debout près de son banc sans oser lever la tête.)

*M. Hamel.* Je ne te gronderai pas, mon petit Frantz; tu dois être assez puni. Voilà ce que c'est, tous les jours on se dit: "Bah! J'ai bien le temps. J'apprendrai demain." Et puis tu vois ce qui arrive. Ah ça a été le grand malheur de notre Alsace; toujours remettre son instruction à demain. Maintenant ces gens là sont en droit de nous dire: "Comment vous prétendiez être français, et vous ne savez ni parler, ni écrire votre langue?" Dans tout cela, mon pauvre Frantz, ce n'est pas encore toi le plus coupable. Nous avons tous notre part de reproches à nous faire. (On entend les pigeons qui roucoulent.

Une petite fille assise près de la fenêtre fait la question.)

*La Petite Fille.* Est-ce qu'on va les obliger à chanter en allemand eux aussi?

*M. Hamel (sourit tristement et caresse sa chevelure blonde).* La langue Française, mes enfants, c'est la plus belle langue du monde, la plus claire, la plus solide. Il faut la garder entre vous et ne jamais l'oublier, parceque, quand un peuple tombe esclave, tant qu'il tient bien sa langue, c'est comme s'il tenait la clef de sa prison.

Eh bien! Passons à l'écriture. Prenez vos cahiers et vos plumes. (M. Hamel écrit sur le tableau noir en grandes lettres: "ALSACE—LORRAINE." Les élèves se mettent à écrire.)

*M. Hamel.* Maintenant, vous, mes petits, nous allons chanter nos lettres.

*Les Élévès.* B-a, ba; b-e be; b-i bi; ba, be, bi; b-o, bo; ba, be, bi, bo; b-u, bu; ba, be, bi, bo, bu.

(Le vieux Hauser met ses lunettes, et il épelle les lettres avec les élèves. Sa voix tremble d'émotion. Tout à coup l'horloge de l'église sonne midi, puis l'angelus. Au même moment, les trompettes des Prussiens éclatent sous les fenêtres. M. Hamel, se lève, tout pâle dans sa chaire, et dit.)

*M. Hamel.* Mes amis, mes amis—je—je—(Il se tourne vers le tableau noir, prend un morceau de craie, et en appuyant de toutes ses forces il écrit aussi gros qu'il peut: "VIVE LA FRANCE!" Puis il reste là, la tête appuyée au mur et sans parler; avec sa main il fait signe.) Allez vous en. *C'est fini.*

**History, Ninth and Tenth Grades:** (GUDRUN THORNE-THOMSEN.) The class has not been able to accomplish so much work as has been outlined for the previous months, so that for the month of May nothing new has been planned.

**Physiography, Ninth Grade:** (WALLACE W. ATWOOD.) Subject: THE OCEAN. Excursions to the Lake Michigan shores and

to the museums will be made when possible. Laboratory work in the study of sea-water and sea-life will also be introduced.

I. Form and extent. (Study relief globes.)

1. As compared with land.
2. In northern and southern hemispheres.

II. Exploration of the ocean. Examination of instruments in museums.

1. Sounding instruments and water-bottle.
2. Deep-sea thermometers.
3. Dredges.

III. Depths. Draw cross-section to different scales.

1. Greatest.
2. Average.

IV. Topography of the ocean-bottom. Study routes of cables.

1. The general features include broad plains, low ridges, shelves, mountains, and cliffs.
2. Compare with topography of the land. What are the reasons for the differences in the topography of the land and that of the sea-bottom?

V. Deposits on the ocean-bottom. Examine specimens in museums.

1. Kinds of materials:
  - (a) From the land.
  - (b) From the air.
  - (c) From the water.
2. Distribution of sediments. How are sediments deposited in Lake Michigan?
  - (a) Of gravels, sands and clays.
  - (b) Of meteoric material.
  - (c) Of oozes.
  - (d) Explain distribution.

VI. Composition of ocean-water. Laboratory experiments with salt solutions.

1. Kinds and amounts of salts in solution.
2. Gases of sea-water.
3. Variations in salinity. Compare saltiness in Doldrum belt, Arctic regions, and portions near river mouths, with that of the water in the trade-wind belts.

4. Influence of salt on:

- (a) Taste.
- (b) Density.
- (c) Freezing-point.
- (d) Clearness.
- (e) Viscosity.

VII. Density of sea-water depends on:

1. Temperature.
2. Salinity.
3. Depth.

VIII. Temperature of the sea. Study charts.

1. Surface variations. Compare with variations on land.
2. Vertical variations:
  - (a) In high latitudes.
  - (b) In low latitudes.
3. Changes in density with changes in temperature.
4. Influence of differences in temperature on circulation.
5. Temperatures of inclosed seas.
  - (a) Red Sea.
  - (b) Mediterranean Sea.
  - (c) Caribbean Sea.

IX. Ice of the sea. Pictures and lantern-slides will be used in this work.

1. Temperature of freezing.
2. Depth of freezing.
3. Geographic distribution.
4. Forms:
  - (a) Flows.
  - (b) Packs.
  - (c) The ice-foot.
  - (d) Bergs.
  - (e) Ground ice.

X. Movements of the sea. Study wave action at the shore of Lake Michigan.

1. Kinds of movement:
  - (a) Waves.
  - (b) Currents.
  - (c) Drift.
  - (d) Creep.
  - (e) Tides.
2. Causes of movement:
  - (a) Winds.
  - (b) Unequal density.
  - (c) Earthquakes.
  - (d) Varying attractions of sun and moon.
3. Discuss the nature and cause of each class of movement, and also the influence of each movement upon shore-lines, climate, navigation, or however shown.

XI. Life of the sea. Study pictures, lantern-slides, and specimens in museums.

1. Plant life:
  - (a) Distribution.
  - (b) Characteristics.
2. Animal life:
  - (a) Distribution; the littoral fauna, the surface fauna, the ocean-bottom fauna.
  - (b) Characteristics of each fauna.
  - (c) Corals and coral formations might well come in at this point, but they were discussed during the study of shore-lines.

XII. Offices of sea.

1. Supplies most of the moisture to the atmosphere.
2. Regulates in part the distribution of temperature.
3. Wears away the shores.
4. "Receives and preserves the materials out of which new land will in course of time be formed."

**Art Expression:** Ocean scenes in various latitudes by means of chalk and water-colors.

**References:** Davis, *Physical Geography*; Mill, *Realm of Nature*; Geikie, *Elementary Lessons in Physical Geography*.

**Mathematics, Ninth and Tenth Grades:** (GEORGE W. MYERS.)

**EXPERIMENT NO. 26.** Find the length of earth's radius by Wallace's method.

Let  $A, B, C$  of the figure be the tops of three posts of same height above water-level set up along the shore of Lake Michigan or by the side of a straight canal. Sighting from  $A$  over  $B$  the line of sight will cut the vertical post at  $C$  at a point  $D$  above  $C$ . The points  $A, B$ , and  $C$  will be on a circumference concentric with the circumference  $a, b, c$  of the earth's surface. Let  $CD, BD$ , and  $AD$  be measured. Suppose the vertical  $Dc$  meets the circumference  $A, B, C$  at  $d$ .

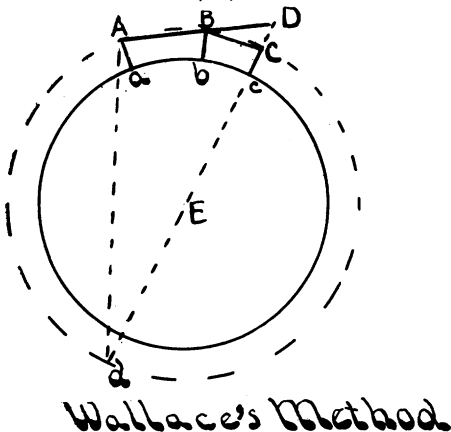


Fig. 23.

Then by elementary geometry, since  $BA d = BCD$ , and  $BDC$  is common to the triangles  $BCD$  and  $DA d$ , these two triangles are similar, and

$$\frac{dD}{AD} = \frac{BD}{CD}, \text{ or } dD = \frac{BD}{CD} \times AD.$$

But  $dD = 2r$  (nearly);  $r$  denoting the radius of the earth. Hence

$$r = \frac{1}{2} \frac{BD}{CD} \times AD.$$

**EXPERIMENT NO. 27.** To find the radius of the earth.

After the latitude and longitude of points on the earth's surface are found, it is possible to determine the radius of the earth in miles. The geographical co-ordinates of the Observatory of Berlin are given in the Jahrbuch as Longitude  $+0^h. 0^m. 0^s.$  and Latitude  $+52^\circ 30'.2$ , and for Cape Town, South Africa, Longitude  $-0^h. 20.3^m.$  and Latitude  $-33^\circ 56'$ . Supposing the earth to be a sphere, and that the two stations, as  $B$  and  $C$ , lie on the same meridian (which is roughly true for Berlin and Cape Town, and the discrepancy can be allowed for), compute the radius of the earth,  $BE$ , and the

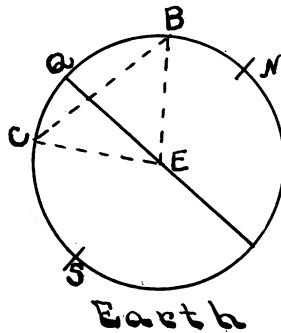


Fig. 24.

chord extending from Berlin,  $B$ , to Cape Town Observatory,  $C$ , assuming the measured length of the great circle arc,  $CQB$ , to be 6,495.6 miles.

Using the 18" terrestrial globe and scale of both miles and degrees, determine the radius of the earth from measures of arcs of great circles between various places.

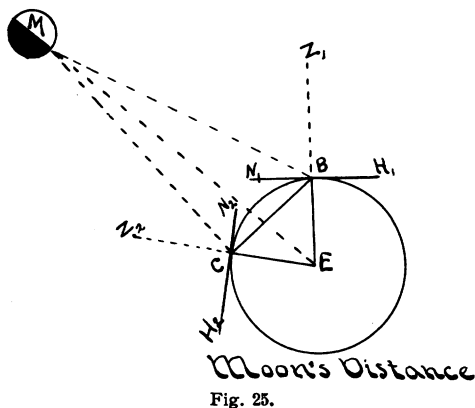
Hipparchus found that on March 31st at noon the sun shone vertically into a deep well at the city of Syene, 500 miles south of Alexandria, while at the latter place the gnomon showed that at noon of the same day the sun was south of the zenith by  $\frac{1}{10}$  of a circle ( $= 7^\circ.2$ ). What would these data indicate the circumference and radius of the earth to be?

[NOTE: The arc Berlin-Cape Town is not the one actually used; but it will suffice to illustrate the method as well as the one actually used, and these stations are needed in the next experiment.]

**EXPERIMENT NO. 28.** To find the distance to the moon.

The stations used above, Berlin and Cape Town, will exemplify the present problem. The observer at Berlin,  $B$ , measures the altitude,

$N_1 B M$ , or zenith distance,  $Z_1 B M$ , of the moon, by means of the most accurate instruments available, constructed on the principles crudely represented in our hand quadrant, or Tycho's quadrant described in the April number of the COURSE OF STUDY. So also does the observer



at the Cape Observatory,  $C$ , measure the zenith distance,  $Z_2 C M$ , or the altitude,  $N_2 C M$ , at the same time as does the observer at  $B$ . The time is set by previous agreement. The former experiment gave us  $B E (= E C)$  and  $B C$ . The sum of the latitudes being  $B E C (= 96^\circ 26'.2)$ , one-half the difference between  $180^\circ$  and  $B E C$  gives  $E B C$ , or  $E C B$ . Having measured  $Z_1 B M$  and  $Z_2 C M$ , the former added to  $E B C$  and the sum deducted from  $180^\circ$  will leave  $M B C$  in degrees, and the latter added to  $E C B$  and the sum subtracted from  $180^\circ$  will leave  $B C M$ . Knowing  $B C M$ ,  $C B M$ , and  $B C$ , we solve the triangle by geometry, or better, by trigonometry, and obtain  $B M$  and  $C M$ , and finally  $E M$ , the desired distance from the moon to the earth.

Supposing the Berlin observer finds the zenith distance,  $Z_1 B M$ , of the moon to be  $53^\circ 15'.1$ , at the instant that the Cape Town astronomer finds the zenith distance,  $Z_2 C M$ , to be  $34^\circ 28'.$  How far is the moon from the earth; i. e., how long is  $E M$ , if the radius of the earth is 3,963 miles?

EXPERIMENT NO. 29. To find the distance from the earth to the sun.

(a) By Aristotle's method.

Note the length of the interval of time from new moon to first quarter as indicated by the straightness of the terminator. Knowing then the length of the lunation, 29.53 days (synodic month, time from new moon to new moon again), and that the moon moves through  $360^\circ$  during this lunation, the angular velocity of the moon, and hence the angle  $S E M$ , is obtained. The angle at  $M$  being right ( $90^\circ$ ) at this instant, a small right triangle may be constructed on paper having any convenient length for  $M E$  (which represents the distance to the moon found in the last experiment), and the known values for  $S M E$  and  $M E S$ , from which the length of the hypotenuse may be read to the scale on which  $M E$  represents the lunar distance. The hypotenuse so expressed will represent the distance to the sun.

Using times of new moon and first quarter from a common patent medicine almanac, and 238,000 miles for the lunar distance, find the sun's distance. Solve the problem both geometrically and trigonometrically if you can.

(b) Geometrical methods by transits of Venus will be given after the method of finding relative planetary distances is developed.

EXPERIMENT NO. 30. To find distances from sun to Mercury and Venus in terms of earth's distance from the sun.

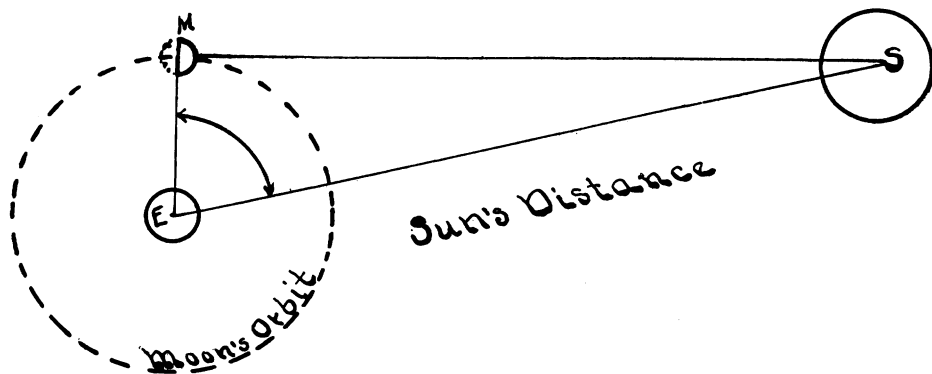


Fig. 28.



The earth,  $E$ , and Venus (the method will be seen to apply to Mercury also),  $V$ , revolve round the sun,  $S$ , in the same direction, the earth

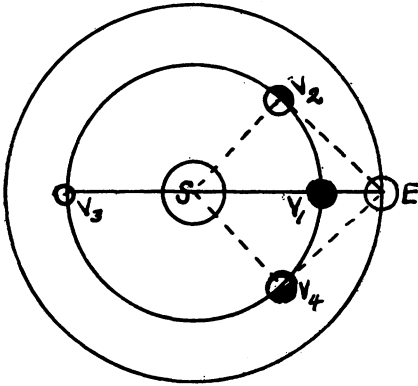


Fig. 27.

moving more slowly. When Venus comes into line with the earth and sun, as at  $V_1$ , we say the planet is in *inferior conjunction*, and when it is at  $V_2$  it is said to be in *superior conjunction*. When the planet has swung out its farthest from the sun, as at  $V_2$  or  $V_4$ , it is said to be at *greatest elongation, eastern or western*. Note that at this instant the angle at the planet in the triangle  $SV_1E$ , or  $SV_4E$ , is right. The angle at  $E$  may be measured directly, or it may be obtained from a common almanac. Then assuming any desired scale for  $SE$ , a right triangle may be constructed on paper, having the angles  $E$  and  $S (=90^\circ - E)$  at the ends of  $SE$ .  $SV_2$ , or  $SV_4$ , will then denote the required distance. It may be measured by noting the mean time when Venus (or Mercury) crosses the meridian, and then converting the time interval into angle by multiplying the hours, minutes, and seconds by 15.

When  $SE$  is known,  $SV$  may be stated in miles. This same method holds good for either Mercury or Venus; but for no other planets.

Solve this problem both geometrically, by drawing to scale, and trigonometrically, using data of almanac.

**EXPERIMENT NO. 31.** To find distance from sun to Mars, or to any planet whose orbit lies beyond that of the earth. (The period of revolution of Mars is supposed to be known. Call it 687 days.)

At any instant measure the angle  $SE_1M$  at the earth between the sun and Mars. Six hundred and eighty-seven days afterward Mars will be in the same place again, but the earth

will have moved around twice, lacking 43.5 ( $2 \times 365.25 - 687$ ) days. Measure the angle  $SE_1M$  at this time, and remembering that the earth moves over  $360^\circ \div 365 \frac{1}{4}$  daily, we have only to multiply  $\frac{360^\circ}{365.25}$  by 4 to obtain the angle  $ESE_1$ . Since  $SE$  and  $SE_1$  are supposed equal and known, a quadrilateral may be readily drawn to scale,

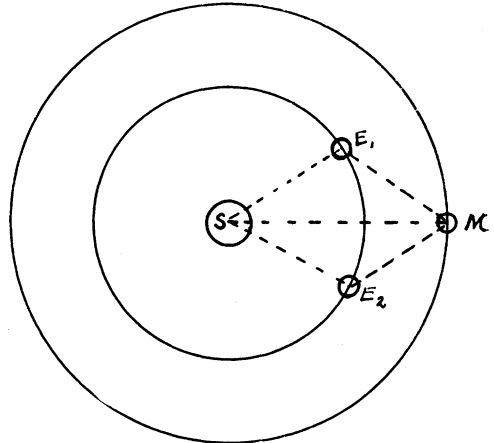


Fig. 28.

from which the straight line  $MS$  may be read. Obviously, this process is applicable to any planet beyond the earth, as soon as its period is known, and this may be obtained by direct observation, as we hope to show later. Using observed data, or data of the Ephemeris, compute the distance from Mars to sun, and do same for other planets.

[NOTE: The last two experiments show how the distances of all the planets are made to depend upon the earth's distance by the simple geometric treatment of observational data. It is with the hope of getting the earth's distance more accurately than ever before that astronomers are giving so much work just now to the little planet called Eros. Whatever error remains in the earth's distance vitiates all other distances and dimensions, not only in the solar system, but throughout the stellar universe.]

**EXPERIMENT NO. 32.** To find the distance from the sun to a star.

Let  $S$  represent the sun and  $E_1ME_2N$  the orbit of the earth. Let  $B$  denote the position of a star, say of Alpha Centauri. On a certain date the star  $B$  seen from  $E_1$  would be projected on the sky among the stars  $CDEF$ . Six months later the earth has been carried in its annual journey to  $E_2$  (186,000,000 miles from

$E_1$ ), and star  $B$  is then seen projected among the stars  $G H J K$ . This apparent displacement is measured by the arc  $xy$ , or by the angle

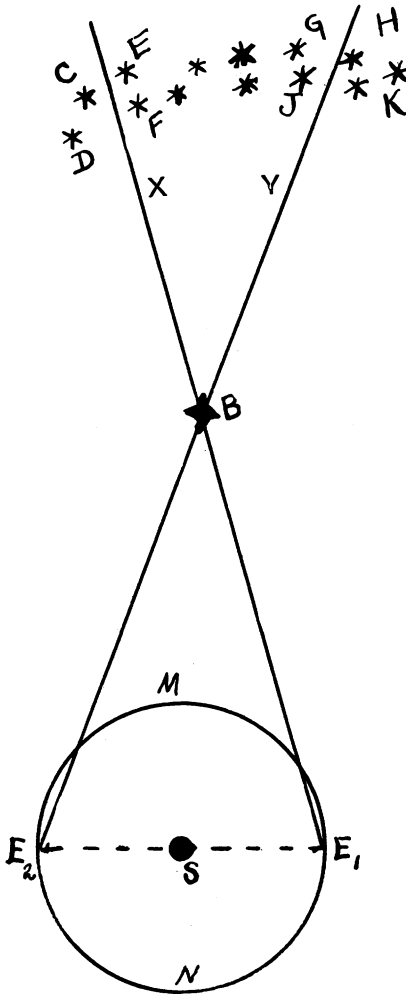


Fig. 29.

$\angle B y = \angle E_1 B E_2$ , and it is obviously due to the observer's 186,000,000-mile shift of position in space, and not to any real change of position of the star  $B$ . If an observer were supposed to be

on  $B$  and looking toward the earth, and the line  $E_1 E_2$  were visible to him, we might say the angle  $E_1 B E_2$  is the apparent angular diameter of the earth's orbit.

Now Experiment No. 6 taught us the law connecting the apparent angular dimensions of a line with its distance from the observer. Further experimenting would show us that if an object is viewed at a distance of 206,265 times its own dimensions it would open up an angle of one second of arc at the observer's eye. Experiment No. 6 shows that the apparent angle varies inversely as the distance. If the apparent angle is half a second, the object is  $2 \times 206,265$  times its own dimensions from the observer, etc. Half of this angle  $E_1 B E_2$  is called the star's *parallax*.

If a star has a parallax of one second, it is then 206,265 times 93,000,000 miles from the eye; if the parallax is  $0''.8$  the star's distance is  $\frac{206,265 \times 93,000,000}{0''.8}$  and, in general, if the star's parallax is denoted by  $p''$  and its distance in miles by  $D$ , we have  $D = \frac{206,265 \times 93,000,000}{p''}$ .

For most stars  $p''$  is small, and  $D$  is so large a number that a longer unit than the mile is preferable. The ordinary unit is the *light-year*, which is the distance that light travels in one year at the rate of 186,000 miles ( $=300,000$  kilometers) per second.

Find the distance in miles and light-years to the stars tabulated here from the parallaxes placed beside them:

STAR.	PARALLAX.
1. $\alpha$ Centauri	$0''.75$
2. 61 Cygni	$.40$
3. Procyon	$.27$
4. 70 Ophiuchi	$.25$
5. Vega	$.16$
6. Polaris	$.074$

Prove that  $D = \frac{3.26}{p''}$  gives the distance to any star in light-years,  $p''$  being the parallax of the star in seconds, and  $D$  the distance from it to the earth, or sun, in light-years.

## Eleventh and Twelfth Grades

**Twelfth Grade History:** (EMILY J. RICE.)

The work for April followed two lines—the westward movement of the American people in their occupation of the Northwest Territory, and the purchase of Louisiana and the history of cotton culture. We traced cotton through the primitive methods of manufacture to the factory system and the establishment of the industry in the United States. These two lines of work led to a consideration of the development of the tariff and of internal improvements.

The interest of the pupils has been greatly stimulated by the plan for the spring term's work in home economics and art. In these departments the pupils have studied the effects of the specialization of industries upon the home, and have considered house decoration with especial reference to textiles. They have also begun some work in decorative needlework. In May and June they will continue the study of house decoration and work out designs for wall decoration. They will also study some typical specimens of recent architecture.

In history we shall continue the study of the westward movement of the American people with changes in methods of transportation. We shall trace the influence of cotton upon slavery, the political issues growing out of the slavery question, and the effects of the factory system of industry upon social and political life.

**Literature:** Ruskin's *Crown of Wild Olive* and Emerson's *Conduct of Life*.

**Domestic Science, Eleventh and Twelfth Grades:** (ALICE P. NORTON.) The work for this quarter is closely related to the history. While in that subject the class are studying the industrial development of the last hundred years they are discussing, in domestic science, the influence upon the home life of the people of the most im-

portant industrial and social changes of the century.

The pupils suggested as some of these changes the greater concentration of the population in cities; the development of the factory system; the specialization of labor; the growth of sanitary science; the changed economic condition of women. Some of the effects upon the home have been to make it less permanent, to divide the interests of the family; and on the other hand, to broaden the outlook, to make beauty and comfort available for the average home, to relieve the home of unnecessary labor.

During the discussion, the importance of the home life of a people was emphasized, and the fact that many of the forces which are tending to disintegrate the home may, rightly used, help to elevate it.

What constitutes an ideal home is the topic now under consideration. The two elements in the home—the family and the house—are seen to be necessary. The ideal home demands in the house good sanitary conditions; beauty, both of surroundings and interior; convenience of location and arrangement, and a certain degree of isolation. On the family side there must be love, a certain degree of unity of purpose, harmony of thought and feeling, and a spirit of helpfulness. There must be enough money to give freedom from worry over financial matters, and a certain amount of leisure; and there must be such an apportionment of the income as will insure support for the "higher life" of the household.

The work for May will be the study of the location, architecture, and plan of the house, and of its plumbing, ventilation, and heating. Special topics are assigned to different members of the class.

**Mathematics, Eleventh and Twelfth Grades:** (GEORGE W. MYERS.) The work of these grades for May will consist of two lines of study; one applied and the other theoretical.

I. The applied work will be assisting in the construction of a topographic map, these grades giving their particular attention to those parts of the work in which trigonometric methods are of especial value. The triangulation of obstructed lines, the more accurate determination of magnitudes not easily furnished by geometry, will make up the greater part of the field-work.

II. The theoretical work will consist, first, of a careful restudy of the following geometrical principles and propositions, preparatory to spherical trigonometry, an introduction to which will be given in connection with the work in geography and astronomy; second, of a review of plane trigonometry through the problems to be solved in the construction of the proposed map of Lincoln Park; and third, enough spherical trigonometry to make the construction of the common almanac theoretically and practically intelligible.

The class will demonstrate these geometrical propositions and principles:

1. The dependence of the spherical triangle upon its correlative trihedral angle.
2. The sides and angles of a spherical triangle are independent of the length of the radius of the sphere.
3. Either side of a spherical triangle is less than the sum of the other two.
4. If two sides of a spherical triangle are unequal, the angles opposite are unequal, and the greater angle lies opposite the greater side, and conversely.
5. The sum of the sides of a spherical triangle is less than  $360^\circ$ .
6. The sum of the angles of a spherical triangle is greater than  $180^\circ$  and less than  $540^\circ$ .
7. If the first of two spherical triangles is polar to the second, then the second is also polar to the first.
8. In two polar triangles, each angle of the

one is measured by the supplement of the side lying opposite in the polar.

9. Derive the formulas for the spherical right triangle, and note that the derivation merely consists in reducing solid or space angles to plane angles.

10. Study the astronomical triangle when it is right-angled.

11. Graduation of sun-dials, etc.

12. Determination of times of rising and setting of sun, moon, and stars leads to the study of the quadrantal triangle, which will be considered next.

**Chemistry, Eleventh and Twelfth Grades:** (ALICE P. NORTON.) The work of April began with a study of the occurrence of minerals and their formation in the earth. Laboratory experiments were given to answer questions which arose concerning solubility and crystallization. The study of the carbonates was begun, and will be completed in May. This will involve a thorough review of carbon dioxide, and of the elements with which it combines, as well as the study of the minerals in their present form. The next groups discussed will be the sulphides and sulphates.

#### EXPERIMENTS.

1. Place 10 grams of sodium acetate in a test-tube, add 10 c.c. of water, and warm until the acetate has entirely dissolved. Place a little cotton wool in the mouth of the tube, set it aside, and allow to cool perfectly without moving. The liquid should be clear. Now drop into the liquid a small crystal of sodic acetate and observe the effect.

2. Put about 0.5 gram  $\text{Pb Cl}_2$  into a test-tube with 10 c.c. of water. Boil for a minute or two and then filter quickly but carefully, receiving the filtrate in a clean test-tube kept warm by being immersed in a beaker of hot water. When the liquid has filtered through, remove the test-tube from the hot water and allow to cool. Examine the product under a microscope.

3. Weigh carefully a covered porcelain crucible. Place in it about three grams of crystallized barium chloride and weigh. Heat the crucible, then allow it to cool, and again take the weight. Repeat to constant weight. Calculate the percentage of water of crystallization in the sample of barium chloride used.

4. Pass carbon dioxide into 10 c.c. of lime-water in a test-tube until the liquid becomes clear; then boil the solution.

**References:** Scott, *Geology*; Brush and Penfield, *Determinative Mineralogy*; Storer and Lindsay, *Manual of Chemistry*; Ruskin, *Ethics of the Dust*.

**German, Twelfth Grade:** (DR. SIEGFRIED BENIGNUS.) The recent war with Spain will be a subject for exercises in style. The literary study will treat of the Suabian Circle of poets: Ludwig Uhland, Gustav Schwab, Justinus Kerner, Wilhelm Hauff, Eduard Möricke.

Memorizing: Selections from Uhland's *Spring Songs*.

#### **Fruhlingsahnung**

O sanfter, süsser Hauch!  
Schon weckest du wieder  
Mir Frühlingslieder.  
Bald blühen die Veilchen auch.

#### **Fruhlingsglaube**

Die linden Lüfte sind erwacht,  
Sie säuseln und weben Tag und Nacht,  
Sie schaffen an allen Enden.  
O frischer Duft, o neuer Klang!  
Nun, armes Herze, sei nicht bang!  
Nun muss sich alles, alles wenden.

Die Welt wird schöner mit jedem Tag,  
Man weiss nicht, was noch werden mag,  
Das Blühen will nicht enden.  
Es blüht das fernste, tiefste Thal;  
Nun, armes Herz, vergiss der Qual!  
Nun muss sich alles, alles wenden.

#### **Fruhlingstrost**

Was zagst du, Herz, in solchen Tagen,  
Wo selbst die Dornen Rosen tragen?

#### **Lob des Frühlings**

Saatengrün, Veilchenduft,  
Lerchenwirbel, Amselschlag,  
Sonnensegen, linde Luft!

Wenn ich solche Worte singe,  
Braucht es dann noch grosser Dinge,  
Dich zu preisen, Frühlingstag?

*Ludwig Uhland, 1787-1862.*